The Tip of the Iceberg: How Pipette Tips Influence Results. Part 4: How to Save Money at the Wrong End

MURIEL ART, VINCENT DUFEY, ION GLIGOR, EPPENDORF APPLICATION TECHNOLOGIES S.A., NAMUR, BELGIUM
ULRIKE GAST, LAURA KOCH, RONJA KUBASCH, EPPENDORF AG, HAMBURG, GERMANY

Abstract

With some manufacturers' tips it makes a difference if in serial pipetting (e.g. calibration), a new tip is used for each pipetting or if the series is pipetted using only one tip. This influence on the pipetting result is caused by variations in pipette tip quality. Eppendorf pipette tips were found not to influence the pipetting results regardless if tips were changed or not.

Introduction

When performing a pipetting series, have you ever thought about using one tip for the whole task or a new tip for each pipetting? When performing a calibration, the international standard ISO 8655 [1] advises to use a new tip for each measurement. But is this really needed?

In the previous parts of this series, we have already shown that tips can influence the pipetting result by shape, perfection of the tip's orifice geometry, and certain methods like autoclaving. In this study, we show that the tip-to-tip quality, meaning the uniformity of tips within one box, between boxes, and between batches is an important influencing factor.

Material and methods

Calibrations with and without tip change were performed using an Eppendorf Xplorer® pipette and 1,000 µL tips from different manufacturers [2].

Results and discussion

The calibration with and without tip change resulted in a clear influence of the method on the calibration result with some manufacturers' tips. This impact was determined especially for the random error [2]. The random error predominantly encompasses all non-systematic influences: It depicts an influencing factor with varying impact. Since the system stayed the same for all calibrations, we deduce that this increase in random error is evoked by variations between tips. To explain this, Fig. 1 shows the calibration results obtained with 1,000 µL pipette tips of Eppendorf and manufacturer E. For calibration results of all manufacturers please refer to [2].

With tips of manufacturer E the system exceeded the systematic error with and without tip change. This is likely to be caused by the tip's shape. However, the picture completely changes when looking at the random error: Here the system performed within the random error limit when re-using the tip. If a new tip was attached for each individual measurement – as advised by ISO 8655 [1] – the system exceeded the random error.

This is a clear sign for greater variations in tip-to-tip quality. Such variations from tip to tip are predominantly caused by poor manufacturing quality.

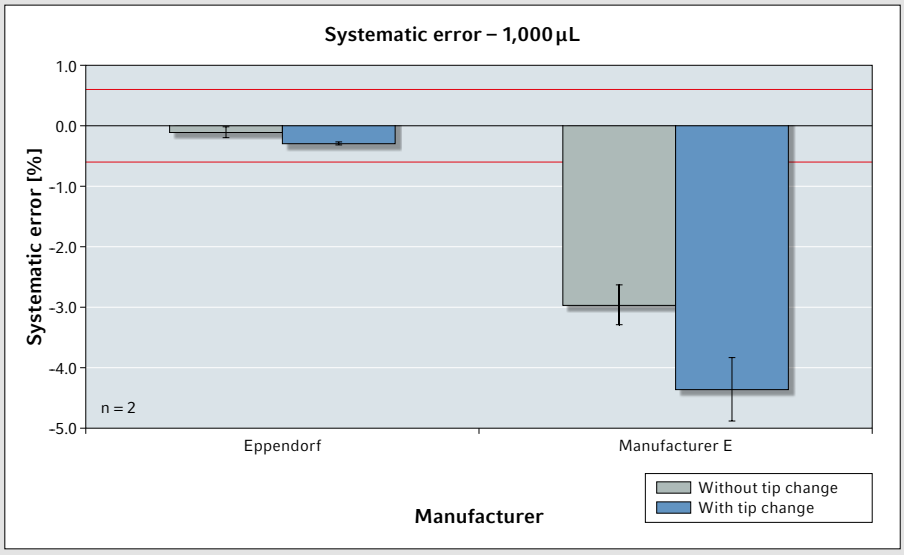
In production, the most important factors for tip quality are:

> Fine-tuning of injection molding process

> Tool quality

> Material

> Small production tolerances and extensive quality control



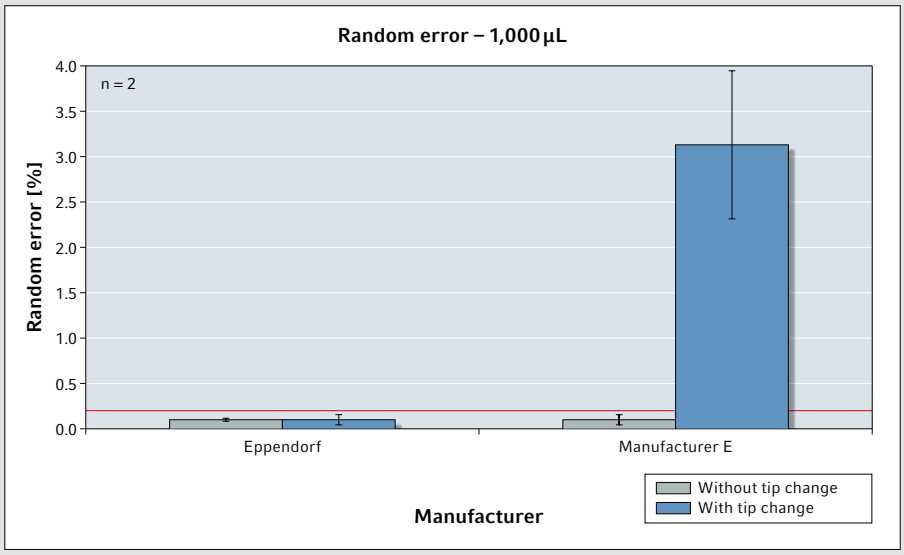


Fig. 1: Calibration results using 1,000 µL tips of Eppendorf and manufacturer E with and without tip change

The Tip of the Iceberg: How Pipette Tips Influence Results. Part 4: How to Save Money at the Wrong End

The tools are the "sacred cores" of any tip production. Their perfection of shape and surface is of significant importance for the tip quality. During tip production, the tools must withstand e.g. a pressure of over 1,000 bar. This means a high load. Consequently, the maintenance cycles of the tools play an important role in product quality. However, the maintenance of tools is a time-, man-power-, and material-consuming process, in short: cost-intensive. Of course, it is possible to use the tools until they are no longer dimensionally stable.

This reduces costs but also reduces the product quality. Hence, the frequency of tool maintenance is driven by the product's compliance with production tolerances. Production tolerances are set by each manufacturer individually and are used to define if the manufactured tips are okay or not.

Eppendorf conducts intensive quality control by short sampling cycles and a high number of tests. Two labs are responsible for the quality testing, a dimensional testing lab and an applicational testing lab. The labs apply narrow error tolerances, leading to Eppendorf's high and reproducible tip quality. Indeed no influence of tip change on the calibration results was discovered in our study [2].

Conclusion

Manufacturers of pipettes and tips, so-called system providers, offer their customers a widely unnoticed additional service: They produce a system instead of single parts. This means, for example, that the production tolerances of the pipette cone are aligned to the production tolerances of the tips. Coordination of the production tolerances is a feature which a non-system provider cannot achieve. Furthermore, based on ISO 8655, system providers have a natural interest to ensure (and certify) that the manufactured system "pipette and tip" performs within the published error tolerances at the date of purchase.

This means that system providers take care that the production tolerances for tips are tight enough to be able to certify the system being within published error limits – regardless of the batch or individual tip.

Manufacturers exclusively producing tips do not have this requirement, thus have the freedom to apply wider production tolerances – to the detriment of the product quality.

The international standard ISO 8655 advises to calibrate pipettes with changing the tip for each measurement. Thus it focuses the performance of the system.

Pipette tips of high quality and homogeneity do not show a relevant influence on the pipetting result.

Only with tip change, variations caused by poor tip-to-tip quality can be detected. It has to be taken into account that the system can be adjusted to a failed systematic error but cannot be adjusted to a failed random error, as caused by poor tip-to-tip quality.

In contrast, a calibration without tip change would only focus on the performance of the pipette. It would only be possible if tips of homogeneous quality were used. With such tips of high homogeneity it would not make a relevant difference if in the daily lab routine a pipetting series is performed with or without tip change.

Within this series we have seen that tips may influence the pipetting result by their shape and the quality of orifice. Also certain methods like autoclaving and tip change can influence the tip and thus the pipetting accuracy and reproducibility. These results are in accordance with the recommendations of the ISO 8655 which describes that pipettes and tips build a system which needs additional calibration if alternative tips are used. In order not to save money at the wrong end, pipette tips should be chosen with the same care as the pipette.

Literature

[1] DIN EN ISO 8655:2002. Piston-operated volumetric apparatus. Beuth-Verlag, Berlin, Germany

[2] Art M, Dufey V, Gast U, Gligor I, Koch L, Kubasch R: Application Note 354: The Tip of the Iceberg: How Pipette Tips Influence Results. www.eppendorf.com/appnote354